

## REMARKS

The Examiner's courteous telephone interview with the undersigned attorney on June 21, 2006 is appreciated. As indicated during the telephone interview, Applicants wish to bring prosecution of this long-pending application to a favorable conclusion as soon as possible. To that end, and as further noted herein below, various claims have been amended to more particularly claim certain embodiments of the present invention. The Applicants appreciate the Examiner's indication that these amendments would be sufficient to overcome the present rejections under 35 U.S.C. §112, further noted herein below.

Accordingly, Applicants respectfully request reconsideration and further examination of the present application.

### I. Status of the Claims

With this Amendment C, claims 1, 40, 49, 53, 57, 61, 66 and 70 have been amended, these claims now referencing "a polymer backbone containing a linear or branched, substituted or unsubstituted poly(alkylamine)." Support for each of these amended may be found in now canceled dependent claims 5, 41, 51, 54, 58, 62, 67 and 71, respectively. Additionally, claims 1 and 57 have been amended to indicate that the cross-linked polymer electrolyte is inert to lithium metal. Support for this amendment may be found in the application, for example, on page 18, line 27 to page 19, line 23. Claims 6-8, 42, 52, 55, 56, 59, 60, 63-65, 68, 69, 72 and 73 have been amended for purposes of clarification, and/or to correct claim dependencies, in view of these previously noted amendments and claim cancellations. Finally, claims 52 and 74-77 have also been for purposes of clarification, as further detailed herein below.

Accordingly, claims 1-4, 6-40, 42-50, 52, 53, 55-57, 59-61, 63-66, 68-70 and 72-77 are now pending and under consideration.

**II. Rejections under 35 U.S.C. §112**

**A. Claim 52**

The Office has rejected claim 52 under 35 U.S.C. §112, first and second paragraphs, for failing to comply with the written description requirement and for failing to particularly point out and distinctly claim the subject matter that is regarded as the invention (i.e., for being indefinite), due to the phrase "cross-linker derived from a malonaldehyde" therein.

As amended, claim 52 is directed to a polymer electrolyte that comprises a polymer cross-linked with a malonaldehyde. The Office has noted that the specification does mention malonaldehyde. In fact, in discussing the various cross-linkers that may be used, the application specifically identifies malonaldehyde as an option, and furthermore provides a working example wherein such a cross-linker is actually used. (See the application as filed at page 20, lines 8-16, as well as Example 2.)

In view of the foregoing, Applicants respectfully submit that claim 52 satisfies the requirements 35 U.S.C. §112, first and second paragraphs. Accordingly, reconsideration of these rejections is requested.

**B. Claims 1-4, 19-40, 43, 47-50, 53, 57, 61, 66, 70 and 74-77**

Reconsideration is respectfully requested of the rejection of claims 1-4, 19-40, 43, 47-50, 53, 57, 61, 66, 70 and 74-77 under 35 U.S.C. §112, first paragraph, for failure to enable the invention as claimed. In particular, the Office has asserted that the specification, while being enabling for the amine backbone being a poly(alkylamine), it does not reasonably provide enablement for any and all other amines.

As previously noted, in order to expedite allowance of the pending claims, and without commenting on the merits of the present rejection, Applicants respectfully point out that claims 1, 40, 49, 53, 57, 61, 66 and 70, from which all other rejected claims depend, have been amended to include the limitations of now canceled dependent

claims 5, 41, 51, 54, 58, 62, 67 and 71, respectively. Accordingly, these claims now state that the polymer electrolyte comprises a polymer backbone that contains a linear or branched, substituted or unsubstituted poly(alkylamine).

Dependent claims 5, 41, 51, 54, 58, 62, 67 and 71 were not rejected here. Inasmuch as claims 1, 40, 49, 53, 57, 61, 66 and 70 have been amended to include limitations of these dependent claims, Applicants respectfully submit the present rejection is rendered moot. Reconsideration of the present rejection is therefore respectfully requested.

### III. The Claimed Subject Matter

During the above-noted telephone interview, the Examiner indicated it would be helpful to have an explanation of various embodiments of the present invention, with references being provided to exemplary passages in the specification that provide support for those embodiments. In response thereto, Applicants call the Examiner's attention to the following:

#### A. Cross-linked Polymer Electrolyte Inert to Lithium Metal

Claim 1, from which claims 2-4, 6-39 and 74-75 depend, is directed to a covalently cross-linked polymer electrolyte. The polymer electrolyte comprises a polymer backbone containing a linear or branched, substituted or unsubstituted poly(alkylamine), a cross-linker, and a dissolved or dispersed metal salt, **wherein the cross-linked polymer electrolyte is inert to lithium metal.**

Claim 57, from which claims 59, 60 76 and 77 depend, is directed to a battery which, in relevant part, comprises a covalently cross-linked polymer electrolyte having a polymer backbone containing a linear or branched, substituted or unsubstituted poly(alkylamine), a cross-linker, and a dissolved or dispersed metal salt, **wherein the cross-linked polymer electrolyte is inert to lithium metal.**

The present application states, beginning at page 18, line 27 and continuing to page 19, line 23, that:

[i]t is to be noted, however, that selection of the cross-linker or cross-linkers will at least in part be dictated by the application of interest. More specifically, while generally any multi-functional molecule that will react with, for example, a secondary or tertiary amine site to form a covalent bond could be used as a cross-linker, preferably a cross-linker will be selected to yield a resulting functional group that is **inert to**, or even acts to enhance, the ion transport application for which the material will be used. For example, **in lithium anode systems, both the base polymer and the cross-linker functionality are preferably not reduced by the lithium.** Difunctional alkyl and alkylarenes that have two or more leaving groups that allow nucleophilic substitution reactions to take place with the nucleophilic nitrogen atoms (e.g., 1,3-dibromopropane; 1,3-diiodohexane; 1,6-dibromohexane; 1,2-dichloroethane; di(bromomethyl)benzenes; 1,7-heptanediol ditosylate, etc.) will produce cross-linked networks. **In the case of PEI, for example, these cross-linkers produce tertiary ammonium functional groups with acidic protons that could be reduced by the lithium** (producing flammable hydrogen gas), and potentially "kill" the system. However, these sites can be neutralized by treatment with base to form suitably inert tertiary amine sites. On the other hand, reaction of these cross-linkers with N-alkylpolyamines (e.g., poly(N-methylethylenimine), or PMEI) would produce quaternary ammonium functional groups which would be largely **inert to the lithium** and neutralization would not be needed. Either type of polymer (e.g., amine or alkylamine)/cross-linker, however, may be suitable for the so-called "rocking chair" type of system, wherein only lithium ions move and thus there is **no metallic lithium**, provided in this latter case that the system does not interact detrimentally with either the cathode or the anode to

degrade performance either physically (e.g., cause delamination) or chemically (e.g., cause passivation).

Accordingly, Applicants respectfully submit these passages clearly indicate that, in one embodiment, the present invention is directed to a cross-linked poly(alkylamine) electrolyte, suitable for use in lithium anode systems that is inert to, or not reduced by, lithium metal. These passages further indicate that not all cross-linked poly(alkylamines) are inert to, or not reduced by, lithium metal.

#### B. Cross-linked Polymer Electrolyte Comprising Labile Protons

Claim 49, from which claims 50 and 52 depend, is directed to a covalently cross-linked polymer electrolyte which comprises a polymer backbone containing a linear or branched, substituted or unsubstituted poly(alkylamine), a cross-linker, **and labile protons therein in the absence of a protic solvent.**

Claim 53, from which claims 55 and 56 depend, is directed to a fuel cell comprising, in relevant part, a proton-conducting, covalently cross-linked polymer electrolyte membrane, the polymer electrolyte comprising a polymer backbone containing a linear or branched, substituted or unsubstituted poly(alkylamine), a cross-linker, **and labile protons therein in the absence of a protic solvent.**

The present application states, on page 34 (lines 2-12), that:

[i]n yet another embodiment, the polymers of the present invention may be utilized as electrolytes for applications (e.g., fuel cells) involving proton transport or conductance. The present polymers are particularly well-suited for such applications because, due to the presence of the amine groups within the polymer, they possess the inherent ability to form **labile protons.** Stated another way, because the amine group nitrogens may form primary, secondary, or tertiary ammonium salts (as a result of, for example, polymerization, substitution, cross-linking, etc. at the nitrogen

atoms), the polymers may in some instances be inherently protonated (i.e., protons are inherently present within the polymers, not being introduced by means of the addition of a protic solvent for example).

Accordingly, Applicants respectfully submit these passages clearly indicate that, in one embodiment, the present invention is directed to a cross-linked poly(alkylamine) electrolyte that comprises primary, secondary or tertiary ammonium salts, and thus labile protons, which are formed not by the introduction of a protic, or protonating, solvent, but rather result from the formation of the cross-linked polymer electrolyte itself. Additionally, it is to be noted from these passages that not all cross-linked poly(alkylamine) electrolytes would comprise labile protons. For example, a poly(alkylamine) wherein the nitrogen atoms therein are fully substituted would not comprise labile protons upon cross-linking at the nitrogen atom; rather, the resulting cross-linked polymer would comprise quaternary ammonium salts.

#### C. Cross-linked Polymer Electrolyte Comprising an Ion Pair

Claim 66, from which claims 68 and 69 depend, is directed to a covalently cross-linked polymer single ion electrolyte which comprises a polymer backbone containing a linear or branched, substituted or unsubstituted poly(alkylamine), a cross-linker, **and an ion pair, wherein one member of the pair is covalently attached to the polymer backbone and the other is capable of diffusing through the polymer electrolyte** upon the application of an electrical field.

Claim 70, from which claims 72 and 73 depend, is directed to an electrolytic cell comprising, in relevant part, a covalently cross-linked polymer single ion electrolyte which comprises a polymer backbone containing a linear or branched, substituted or unsubstituted poly(alkylamine), a cross-linker, **and an ion pair, wherein one member of the pair is covalently attached to the polymer backbone and the other is**

**capable of diffusing through the polymer electrolyte upon the application of an electrical field.**

The present application states, on page 39 (lines 2-26), that:

[i]t is to be noted that, in one embodiment of the present invention, the polymer electrolyte is prepared such that conductivity is achieved by means of a "single ion" source; that is, conductivity using the polymer electrolyte is achieved by the **movement of only the cations or anions in the system, the corresponding counter-ions being part of the polymer itself and thus not being mobile.**

Without being held to a particular theory, it is generally believed such a system is a significant improvement over existing "two ion" electrolytes because, when subjected to DC current over time, segregation of positively and negative ions occurs, each type of ion accumulating at the corresponding oppositely charged electrode. This build-up of like-charged ions near each electrode surface results in increased internal resistance, and thus decreased current output at a given potential (i.e., voltage) of a battery comprising such an electrolyte. However, this build-up occurs at both electrodes. As a result, a "single ion" electrolyte does not have this problem because only one type can move.

In this embodiment of the present invention, the electrolyte comprises a polymer having ionic substituents (e.g., R<sup>1</sup>) attached to the polymer backbone. These substituents may be present in the monomer, from which the polymer is prepared, or alternatively may be attached to the polymer backbone after polymerization has been completed. Essentially any substituent known to one skilled in the art may be employed, including for example alkylsulfate or alkylsulfonate salts (e.g., sodium methyl, ethyl, propyl, etc. salts), as well as aryloxides (e.g.,

phenoxides, such as lithium phenoxides), alkylcarboxylates and alkylphosphonates.

Accordingly, Applicants respectfully submit these passages clearly indicate that, in one embodiment, the present invention is directed to a cross-linked poly(alkylamine) electrolyte wherein conductivity is achieved by movement of either the anionic or cationic species present therein, rather than both. The other species being part of the polymer itself, this species for example being attached to the polymer backbone. Such a system differs, for example, from conventional polymer electrolytes comprising metal salts, because in such conventional electrolytes both the anion and cation of the salt would diffuse, or be capable of diffusing, through the electrolyte upon the application of an electric field.

The cross-linked poly(alkylamine) electrolyte of the claimed embodiment is illustrated in Example 4, subparagraph E of the present application (which begins at the top of page 69). In this Example, a nitrogen atom of the linear poly(ethylenimine) reacts with 1,3-propanesultone, resulting in the attachment of a propylsulfonate group to the nitrogen atom. Neutralization of the resulting quaternary ammonium salt with lithium hydroxide yields a neutral nitrogen atom, and an ionic sulfonate group attached, by means of the propyl group, to the nitrogen atom, a lithium ion being associated with the sulfonate group. The resulting polymer may be further cross-linked, as detailed in this Example.

#### **IV. Rejections under 35 U.S.C. §102(b)**

Reconsideration of the rejection of claims 1, 6, 8-10, 32, 34-36, 49, 57 and 59 under 35 U.S.C. §102(b) as being anticipated by JP 62-140306 (hereinafter JP '306) is respectfully requested, in as much as Applicants submit that each and every element as set forth in the rejected claims is not described in this patent, as further detailed below.

In the interests of brevity, Applicants will not restate all of the comments previously submitted in their Letter to the Patent Office (dated March 3, 2005), and in

their Amendment B (dated November 7, 2005). Applicants do, however, maintain all of those comments with respect to the present rejection.

A. *Claims 1, 6, 8-10, 30, 32, 34-36, 57 and 59*

The Office states that JP '306 discloses a cross-linked polymer electrolyte having as a polymer backbone material branched polyethyleneimine with a polyfunctional epoxy cross-linking agent and a metal salt. The Office further states the materials exemplified are inert to lithium. Applicants respectfully disagree.

It is noted that JP '306 references forming a cross-linked polyethyleneimine using a polyfunctional epoxy cross-linking agent, and using this cross-linked polymer with an inorganic electrolyte, that may include lithium. However, the mere fact that JP '306 mentions the possible use of the cross-linked polymer with a lithium-containing electrolyte **does not** mean that the cross-linked polymer is inert to lithium metal. Notably, JP '306 makes **no reference** to the polymer electrolyte prepared therein being inert to lithium. In fact, as further detailed in the Declaration of Daniel T. Glatzofe being submitted simultaneously with this Amendment C, Applicants respectfully submit that cross-linking a branched polyethyleneimine with an epoxy compound **does not** result in the formation of a cross-linked polymer electrolyte that is inert to lithium metal. Rather, if a primary or secondary amine moiety is reacted with a diepoxide cross-linker, as set forth in JP '306,  $\beta$ -hydroxyamine groups are formed. These  $\beta$ -hydroxyamine groups will react with metallic lithium, the groups being reduced to form lithium alkoxides, and thus are not inert thereto.

In view of the foregoing, Applicants respectfully submit that JP '306 does not disclose each and every element of either claim 1 or claim 57. Accordingly, reconsideration of the rejection of these claims is respectfully requested.

In as much as claims 2, 6, 8-10, 30, 32 and 34-36 depend from claim 1, and claim 59 depend from claim 57, these claims are submitted as novel over JP '306 for at least the same reasons as those noted for claims 1 and 57, respectively. Although

these claims include additional novel features, these features will not be addressed at this time in the interest of brevity.

*B. Claim 49*

It is noted that, on page 5, second paragraph, the Office states that JP '306 discloses a cross-linked polymer electrolyte having as a polymer backbone material branched polyethyleneimine with a polyfunctional epoxy cross-linking agent and a metal salt in the absence of a protic solvent. It is further noted, however, the Office **does not** state that the electrolyte disclosed in JP '306 comprises **labile protons** in the absence of a protic solvent. Applicants respectfully submit this is because JP '306 in fact makes **no reference** to such an electrolyte. Applicants further submit that **not all** cross-linked polyalkyleneimines contain labile protons in the absence of a protic solvent. (See, e.g., page 35, lines 3-12 of the present application, as well as page 6, third full paragraph of Applicants' Letter to the Patent Office of March 3, 2005). In the case of JP '306, and as further detailed in the above-noted Declaration, if a primary or secondary amine moiety is reacted with a diepoxide cross-linker, as set forth in JP '306,  $\beta$ -hydroxyamine groups are formed. The resulting cross-linked polymer electrolyte is therefore not inherently protonated, and thus does not inherently contain labile protons in the absence of a protic solvent, because the hydrogen atoms that are part of the  $\beta$ -hydroxyamine groups are not sufficiently acidic to have labile protons.

In view of the foregoing, Applicants respectfully submit that JP '306 does not disclose each and every element of claim 49. Accordingly, reconsideration of the rejection of this claim is respectfully requested.

*C. Claims 55, 56, 66 and 68*

Applicants respectfully point out that while paragraph 6 of the present Office action (i.e., the paragraph containing the present 35 U.S.C. §102 rejection) references only pending claims 1, 6, 8-10, 32, 34-36, 49, 57 and 59, the subparagraphs therein

also reference claims 55 and 56 (see first paragraph at the top of page 5), as well as claims 66 and 68 (see the last paragraph at the bottom of page 5 and the first paragraph at the top of page 6). Accordingly, it is unclear whether or not the Office also intended to reject pending claims 55, 56, 66 and 68 under 35 U.S.C. §102 based on JP '306.

With respect to claims 55 and 56, it is to be noted that these claims depend from claim 53. Given that no indication has been made that claim 53 was rejected as anticipated by JP '306, it seems unlikely the Office intended to reject claims 55 and 56, given that the scope of these claims is naturally more narrow than that of claim 53, from which they depend. Accordingly, Applicants believe there is no reason to address claims 55 and 56 here.

With respect to claim 66, from which claim 68 depends, it is to be noted this claim is directed to a covalently cross-linked polymer single ion electrolyte which comprises a polymer backbone containing a linear or branched, substituted or unsubstituted poly(alkylamine), a cross-linker, **and an ion pair, wherein one member of the pair is covalently attached to the polymer backbone and the other is capable of diffusing through the polymer electrolyte** upon the application of an electrical field.

The Office states that JP '306 discloses a cross-linked polymer electrolyte having as a polymer backbone material branched polyethyleneimine with a polyfunctional epoxy cross-linking agent and a metal salt, which generates an ion pair of lithium ions and the corresponding negative ion from the salt. The Office further states that the lithium ions are capable of diffusing through the polymer electrolyte and the negative ions are attracted to and covalently bounded to the electrolyte backbone. Applicants respectfully disagree.

It is noted that JP '306 references forming a cross-linked polyethyleneimine using a polyfunctional epoxy cross-linking agent, and using this cross-linked polymer with an inorganic electrolyte, such as one that contains lithium. However, the mere fact that JP '306 mentions the use of the cross-linked polymer disclosed therein with an electrolyte, such as one that contains lithium, **does not** mean that the cross-linked polymer electrolyte contains an ion pair, wherein one member of the pair is covalently attached

to the polymer backbone and the other is capable of diffusing through the polymer electrolyte upon the application of an electrical field. Notably, JP '306 makes **no reference** to the polymer electrolyte prepared therein containing such an ion pair. In fact, Applicants respectfully submit that cross-linking a branched polyethyleneimine with an epoxy compound in the presence of an inorganic electrolyte **does not** result in the formation of a cross-linked polymer electrolyte that contains such an ion pair, **wherein one member of the pair is covalently attached to the polymer backbone** and the other is capable of diffusing through the polymer electrolyte. Rather, as detailed in the above-noted Declaration, JP '306 discloses a conventional electrolyte, wherein both the anion and cation of the salt diffuse, or are capable of diffusing, through the electrolyte upon the application of an electric field.

In view of the foregoing, Applicants respectfully submit that JP '306 does not disclose each and every element claim 66. Accordingly, reconsideration of the rejection of these claims is respectfully requested.

In as much as claim 68 depends from claim 66, claim 68 is submitted as novel over JP '306 for at least the same reasons as those noted for claim 66.

#### **V. Rejections under 35 U.S.C. §103**

Reconsideration of the present rejections under 35 U.S.C. §103 is also respectfully requested.

In the interests of brevity, Applicants will not restate all of the comments previously submitted in their Letter to the Patent Office (dated March 3, 2005), and in their Amendment B (dated November 7, 2005). Applicants do, however, maintain all of those comments with respect to the present rejection.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the reference itself or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. Second, there must be a reasonable expectation of success. And third, the prior art reference must teach or suggest all of the claim elements. MPEP §2142. In the instant

case, Applicants respectfully submit, for the reasons set forth in detail below, that the claimed inventions are not obvious in view of the cited references because these references, both alone and in combination, **fail to disclose or suggest all of the claim elements**. Additionally, in at least some instances, motivation to combine the cited references is lacking.

A. *Rejection of Claims 1, 2, 6-11, 30, 32, 34, 49, 53, 55-57, 59, 60, 66, 68-70, 72 and 73 as being Unpatentable over Rosenmeier et al. in view of JP '306*

Reconsideration is respectfully requested of the rejection of claims 1, 2, 6-11, 30, 32, 34, 49, 53, 55-57, 59, 60, 66, 68-70, 72 and 73 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of Japanese Patent Publication No. JP 62-140306 (hereinafter "JP '306").

(i) **Claims 1, 2, 6-11, 30, 32, 34, 57, 59 and 60**

In the interests of brevity, Applicants respectfully refer the Office to the comments Applicants provided above under Sections III., A. and IV. A, in support of their position that JP '306 does not disclose or suggest a cross-linked polymer electrolyte that is inert to lithium metal, as required by the above-noted claims. However, Applicants additionally point out that JP '306 arguably **teaches away** from the claimed cross-linked polymer electrolyte because it actually discloses a cross-linked poly(alkylenemimie) that **is not** inert to lithium metal.

With respect to Rosenmeier et al., Applicants submit Rosenmeier et al. do not disclose or suggest a cross-linked polymer having amine groups in the polymer backbone. In this regard, Applicants note that, (i) at column 5, lines 43-65, Rosenmeier et al. provide a long list of exemplary types of polymers, including a type of polymer which has amine groups in the backbone, and (ii) at lines 66-67 of this same column they indicate these polymers **may or may not** be cross-linked. However, there is **no other reference** in this patent to polymers having amine groups in the backbone.

Furthermore, there is **no specific reference to any type of cross-linker**, or to any type of cross-linked polymer having amine groups in the backbone, and therefore there is also **no reference** to such a cross-linked polymer which is inert to lithium.

Accordingly, Rosenmeier et al. do not remedy the deficiencies of JP '306, or vice versa, because Rosenmeier et al. **do not disclose or suggest a cross-linked poly(alkylamine)**. Furthermore, Rosenmeier et al. do not disclose or suggest such a polymer that is inert to lithium metal. Therefore, taken together, Applicants respectfully submit Rosenmeier et al. and JP '306 clearly fail to disclose or suggest all of the claim elements of either claim 1 or claim 57. Claims 1 and 57 are therefore submitted as patentable over the cited references.

Inasmuch as claims 2, 6-11, 30, 32 and 34 depend from claim 1, and claim 59 and 60 depend from claim 57, these claims are submitted as patentable over the cited references for at least the same reasons as those noted with respect to claim 1 and 57, respectively. Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

(ii)      Claims 49, 53, 55 and 56

In the interests of brevity, Applicants respectfully refer the Office to the comments Applicants provided above under III., B. and IV., B., in support of their position that JP '306 does not disclose or suggest a cross-linked polymer electrolyte, or a fuel cell comprising such an electrolyte, that **contains labile protons in the absence of a protic solvent**, as required by the above-noted claims.

With respect to Rosenmeier et al., Applicants submit Rosenmeier et al. do not remedy the deficiencies of JP '306, or vice versa, because, as noted above, Rosenmeier et al. **do not disclose or suggest a cross-linked poly(alkylamine)**. Furthermore, Rosenmeier et al. do not disclose or suggest a cross-linked poly(alkylamine) containing labile protons in the absence of a protic solvent.

Accordingly, taken together, Applicants respectfully submit Rosenmeier et al. and JP '306 clearly fail to disclose or suggest all of the claim elements of either claim 49 or

claim 53. Claims 49 and 53 are therefore submitted as patentable over the cited references.

Inasmuch as claims 55 and 56 depend from claim 53, these claims are submitted as patentable over the cited references for at least the same reasons as those noted with respect to claim 53. Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

(iii) Claims 66, 68, 69, 70, 72 and 73

In the interests of brevity, Applicants respectfully refer the Office to the comments Applicants provided above under III., C., in support of their position that JP '306 does not disclose or suggest a cross-linked polymer electrolyte, or an electrolytic cell comprising such an electrolyte, comprising an ion pair as required by the above-noted claims.

With respect to Rosenmeier et al., Applicants submit Rosenmeier et al. do not remedy the deficiencies of JP '306, or vice versa, because Rosenmeier et al. **do not disclose or suggest a cross-linked poly(alkylamine)**. Furthermore, Rosenmeier et al. do not disclose or suggest a cross-linked poly(alkylamine) comprising an ion pair as required by the above-noted claims.

Accordingly, taken together, Applicants respectfully submit Rosenmeier et al. and JP '306 clearly fail to disclose or suggest all of the claim elements of either claim 66 or claim 70. Claims 66 and 70 are therefore submitted as patentable over the cited references.

Inasmuch as claims 68 and 69 depend from claim 66, and claims 72 and 73 depend from claim 70, these claims are submitted as patentable over the cited references for at least the same reasons as those noted for claims 66 and 70, respectively. Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

*B. Rejection of Claims 3 and 4 as being Unpatentable over Rosenmeier et al. in view of JP '306 and further in view of JP 06-329793*

Reconsideration is respectfully requested of the rejection of claims 3 and 4 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of Japanese Patent Publication No. JP 06-329793 (hereinafter "JP '793").

Applicants respectfully submit that claims 3 and 4 are patentable over the combination of Rosenmeier et al. in view of JP '306 for the reasons set forth above with respect to claim 1, from which claims 3 and 4 depend. Applicants further submit the addition of the reference JP '793 does not remedy the above-noted deficiencies of the disclosure of Ronsenmeier et al. or JP '306, inasmuch as JP '793 fails to disclose or suggest a covalently cross-linked polymer electrolyte having a polymer backbone containing a poly(alkylamine), a cross-linker, and a dissolved or dispersed metal salt, wherein the cross-linked polymer electrolyte is **inert** to lithium metal. In fact, JP '793 arguably **teaches away** from such a cross-linked polymer electrolyte because (i) it discloses the use of diisocyanate cross-linking agents (see, e.g., the Abstract, paragraph [0007] and Formula 1, wherein it is indicated that each "X" of the cross-linking agent is an isocyanate group), and (ii) cross-linking using diisocyanates is known to result in the formation of urethane linkages or functionalities, which **are not inert to lithium metal**.

Accordingly, reconsideration of the present rejection of claims 3 and 4 is requested.

C. *Rejection of Claims 19-22 and 25 as being Unpatentable over Rosenmeier et al. in view JP '036 and of U.S. Patent No. 5,501,919*

Reconsideration is respectfully requested of the rejection of claims 19-22 and 25 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of JP '306, and further in view of U.S. Patent No. 5,501,919 (Paul et al.).

Applicants respectfully submit that claims 19-22 and 25 are patentable over the combination of Rosenmeier et al. in view of JP '306 for the reasons set forth above with respect to claim 1, from which these claims depend. Applicants further submit the addition of Paul et al. does not remedy the above-noted deficiencies of the disclosure of

Ronsenmeier et al. or JP '306. inasmuch as Paul et al. fail to disclose or suggest a covalently cross-linked polymer electrolyte having a polymer backbone containing a poly(alkylamine), a cross-linker, and a dissolved or dispersed metal salt, wherein the cross-linked polymer electrolyte is **inert** to lithium metal. In fact, Applicants submit Paul et al. **fail to disclose or suggest a cross-linked polymer electrolyte of any kind.** Rather, Paul et al. simply disclose the preparation of branched polyethylenimine which has a lithium salt therein (see the Abstract), and one of ordinary skill in the art would recognize branching **is not** the same as cross-linking.

Accordingly, taken together, Rosenmeier et al., JP '306 and Paul et al. fail to disclose or suggest all of the elements of claim 1, and thus of claims 19-22 and 25. Claim 1 is therefore submitted as patentable over the cited references. Inasmuch as claims 19-22 and 25 depend from claim 1, these claims are submitted as patentable over the cited references for at least the same reasons as those noted with respect to claim 1. Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

*D. Rejection of Claims 23, 24, 26 and 29 as being Unpatentable over Rosenmeier et al. in view of JP '306, U.S. Patent No. 5,501,919 and U.S. Patent No. 5,648,186*

Reconsideration is respectfully requested of the rejection of claims 23, 24, 26 and 29 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of JP '306 and Paul et al., and further in view of U.S. Patent No. 5,648,186 (Daroux et al.).

Applicants respectfully submit that claims 23, 24, 26 and 29 are patentable over the combination of Rosenmeier et al., JP '306 and Paul et al. for the reasons set forth above with respect to claim 1, from which these claims depend. Applicants further submit the addition of Daroux et al. does not remedy the above-noted deficiencies of the disclosure of Ronsenmeier et al., JP '306, or Paul et al., inasmuch as Daroux et al. fail to disclose or suggest a covalently cross-linked polymer electrolyte having a polymer backbone containing a poly(alkylamine), a cross-linker and a dissolved or dispersed metal salt, wherein the cross-linked polymer electrolyte is **inert** to lithium metal. In fact,

Daroux et al. arguably **teach away** from such a cross-linked polymer electrolyte because (i) the only specific details they provide with respect to cross-linking involve the use of hexamethylene diisocyanate (see, e.g., column 7, lines 16-20, as well as Examples 2, 4, 12 and 13), and (ii) cross-linking using diisocyanates is known to result in the formation of urethane linkages or functionalities, which are **not inert to lithium metal**.

Accordingly, taken together, Applicants respectfully submit the combination of Rosenmeier et al., JP '306, Paul et al. and Daroux et al. fails to disclose or suggest all of the claim elements of claim 1, and thus of claims 23, 24, 26 and 29. Claim 1 is therefore submitted as patentable over the cited references. Inasmuch as claims 23, 24, 26 and 29 depend from claim 1, these claims are submitted as patentable over the cited combination of references for at least the same reasons as those noted with respect to claim 1. Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

*E. Rejection of Claims 23, 26, 28 and 29 as being Unpatentable over Rosenmeier et al. in view of JP '306, U.S. Patent No. 5,501,919, U.S. Patent No. 5,648,186 and U.S. Patent No. 6,096,453*

Reconsideration is respectfully requested of the rejection of claims 23, 26, 28 and 29 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of JP '306, U.S. Patent No. 5,501,919 (Paul et al.) and U.S. Patent No. 5,648,186 (Daroux et al.), and further in view of U.S. Patent No. 6,096,453 (Grunwald et al.).<sup>10</sup>

Applicants respectfully submit that claims 23, 26, 28 and 29 are patentable over the combination of Rosenmeier et al., JP '306, Paul et al. and Daroux et al. for the reasons set forth above with respect to claim 1, from which these claims depend. Applicants further submit the addition of Grunwald et al. does not remedy the above-noted deficiencies of the disclosure of Ronsenmeier et al., JP '306, Paul et al. or Daroux

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<sup>10</sup> It is noted that, although Daroux et al. is not referenced in the second paragraph of page 12 of the present Office action, Daroux et al. is repeatedly referenced in the text of this portion of the rejection (see paragraphs 2, 3 and 4 on page 13). Accordingly, it is being addressed here, as well.

et al., inasmuch as Grunwald et al. **fail to disclose or suggest** a covalently cross-linked polymer electrolyte having a polymer backbone containing a poly(alkylamine), a cross-linker and a dissolved or dispersed metal salt, wherein the cross-linked polymer electrolyte is **inert** to lithium metal. Grunwald et al. do generally reference numerous polymers, copolymers, etc., some of which would include poly(alkylamines) in the polymer backbone (see, e.g., column 4, lines 40 to column 5, line 58), and they also reference cross-linked polymers, which could include polymers having amines in the polymer backbone (see, e.g., column 10, lines 49-60). However, few details are provided with respect to the cross-linkers that may be used. Furthermore, **there is no reference to cross-linkers that could be employed** with a polymer having amine groups in the backbone, in order **to yield a cross-linked polymer which is inert to lithium metal.**

Accordingly, taken together, Applicants respectfully submit the combination of Rosenmeier et al., JP '306, Paul et al., Daroux et al. and Grunwald et al. fails to disclose or suggest all of the claim elements of claim 1, in as much as these references **collectively fail to disclose or suggest**, and arguably **teach away from**, a cross-linked polymer electrolyte which comprises a polymer backbone containing a poly(alkylamine) that is **inert** to lithium metal.

Claim 1 is therefore submitted as patentable over the cited references. Inasmuch as claims 23, 26, 28 and 29 depend from claim 1, these claims are submitted as patentable over the cited combination of references for at least the same reasons as those noted with respect to claim 1. Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

*F. Rejection of Claims 23, 26, 28 and 29 as being Unpatentable over Rosenmeier et al. in view of JP '306, U.S. Patent No. 5,501,919 and U.S. Patent No. 5,964,903*

Reconsideration is respectfully requested of the rejection of claims 23, 26, 28 and 29 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of

JP '306 and U.S. Patent No. 5,501,919 (Paul et al.), and further in view of U.S. Patent No. 5,964,903 (Gao et al.).

Applicants respectfully submit that claims 23, 26, 28 and 29 are patentable over the combination of Rosenmeier et al., JP '306 and Paul et al. for the reasons set forth above with respect to claim 1, from which these claims depend. Applicants further submit the addition of Gao et al. does not remedy the above-noted deficiencies of the disclosure of Ronsenmeier et al., JP '306 and Paul et al. for reasons previously stated (see, e.g., Amendment B). In short, Gao et al. fail to disclose or suggest a cross-linked polymer electrolyte that is **inert** to lithium metal. In fact, **Gao et al. fail to even reference cross-linking.** Rather, Gao et al. simply disclose plasticizers which are suitable for use in fabricating electrochemical cells (see, e.g., column 1, line 65 to column 2, line 4).

Accordingly, taken together, the combination of Rosenmeier et al., JP '306, Paul et al. and Gao et al. fails to disclose or suggest, and arguably **teach away from**, all of the claim elements of claim 1, and thus of claims 23, 26, 28 and 29. Claim 1 is therefore submitted as patentable over the cited combination of references. Inasmuch as claims 23, 26, 28 and 29 depend from claim 1, these claims are submitted as patentable over the cited combination of references for at least the same reasons as those noted with respect to claim 1. Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

G. *Rejection of Claims 33, 35 and 36 as being Unpatentable over Rosenmeier et al. in view of JP '306, U.S. Patent No. 5,964,903*

Reconsideration is respectfully requested of the rejection of claims 33, 35 and 36 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of JP '306, U.S. Patent No. 5,964,903 (Gao et al.).

Applicants respectfully submit that claims 33, 35 and 36 are patentable over the combination of Rosenmeier et al., JP '306 and Gao et al. for the reasons set forth above under subsection V., F. with respect to claim 1, from which these claims depend. Specifically, this combination of references **collectively fails to disclose or suggest**, and arguably **teach away** from, a cross-linked polymer electrolyte which comprises a polymer backbone containing a poly(alkylamine) that is **inert** to lithium metal.

Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

H. *Rejection of Claims 37 and 38 as being Unpatentable over Rosenmeier et al. in view of JP '306 and further in view of Harris et al.*

Reconsideration is respectfully requested of the rejection of claims 37 and 38 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of JP '306, and further in view of Harris et al.

Applicants respectfully submit that claims 37 and 38 are patentable over the combination of Rosenmeier et al. and JP '306 for the reasons set forth above with respect to claim 1, from which these claims depend. Applicants further submit the addition of Harris et al. does not remedy the above-noted deficiencies of the disclosure of Ronsenmeier et al. and JP '306, for the reasons previously stated (see, e.g., Amendment B). In short, Harris et al. fail to disclose or suggest a polymer electrolyte that comprises a polymer backbone that contains a poly(alkylamine) and that is **inert** to lithium metal. In fact, **Harris et al. do not even reference cross-linking**. Rather, Harris et al. disclose only branched and linear polyethylenimine. As previously noted, **branching is not the same as cross-linking**.

Accordingly, taken together, Rosenmeier et al., JP '306 and Harris et al. fail to disclose or suggest, and arguably **teach away** from, all of the claim elements of claim 1, and thus of claims 37 and 38. Claim 1 is therefore submitted as patentable over the cited references. Inasmuch as claims 37 and 38 depend from claim 1, these claims are submitted as patentable over the cited combination of references for at least the same reasons as those noted with respect to claim 1. Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

*I. Rejection of Claim 39 as being Unpatentable over Rosenmeier et al., JP '306, in view of U.S. Patent No. 5,648,186 and U.S. Patent No. 4,578,326*

Reconsideration is respectfully requested of the rejection of claim 39 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of JP '306, U.S. Patent No. 5,648,186 (Daroux et al.) and U.S. Patent No. 4,578,326 (Armand et al.).

Applicants respectfully submit that claim 39 is patentable over the combination of Rosenmeier et al., JP '306 and Daroux et al. for the reasons set forth above with respect to claim 1, from which these claims depend. Applicants further submit the addition of Armand et al. does not remedy the above-noted deficiencies of the disclosure of Ronseenmeier et al., JP '306, and Daroux et al. for the reasons previously stated (see, e.g., Amendment B). In short, Armand et al. fail to disclose or suggest a polymer electrolyte that comprises a polymer backbone that contains a poly(alkylamine) and that is **inert** to lithium metal. In fact, **Armand et al. do not even reference cross-linking**, or a polymer electrolyte that comprises a polymer backbone that contains a poly(alkylamine). Rather, Armand et al. disclose polymers derived from ethylene oxide (see, e.g., column 1, lines 28-31).

Accordingly, taken together, Applicants respectfully submit the combination of Rosenmeier et al., JP '306, Daroux et al. and Armand et al. fails to disclose or suggest, and arguably **teach away** from, all of the claim elements of claim 1, and thus of claim 39. Claim 1 is therefore submitted as patentable over the cited references. Inasmuch as claim 39 depends from claim 1, this claim is submitted as patentable over the cited

combination of references for at least the same reasons as those noted with respect to claim 1. Although this claim includes additional patentable features, they will not be addressed at this time in the interests of brevity.

J. *Rejection of Claims 74-77 as being Unpatentable over Rosenmeier et al. in view of U.S. Patent No. 3,885,069*

Reconsideration is respectfully requested of the rejection of claims 74-77 under 35 U.S.C. §103 as being unpatentable over Rosenmeier et al. in view of U.S. Patent No. 3,885,069 (Roberts et al.)

Applicants' position with respect to the failures in the disclosure provided by Rosenmeier et al. and Roberts et al., as set forth in Applicants' previously submitted Amendment B, has not changed. In short, Applicants submit that Roberts et al., like Rosenmeier et al., fail to disclose or suggest a covalently cross-linked polymer electrolyte which comprises a polymer backbone that contains a poly(alkyleneimine) and which is **inert** to lithium metal. Furthermore, **nowhere in the present Office action does the Office assert** that Rosenmeier et al. or Roberts et al. disclose or suggest a polymer electrolyte comprising a polymer backbone containing a cross-linked poly(alkylamine) that is **inert** to lithium metal.

Accordingly, claims 1 and 57 are submitted as patentable over the cited references. In as much as claims 74 and 75 depends from claim 1, and claims 76 and 77 depend from claim 57, these claims are submitted as patentable over the cited combination of references for at least the same reasons as those noted with respect to claim 1 and 57, respectively. Although these claims include additional patentable features, they will not be addressed at this time in the interests of brevity.

VI. **Allowable Subject Matter**

Applicants again respectfully acknowledge the Office's finding that claims 40 and 42-48 would be allowable if rewritten or amended to overcome the rejections under 35 U.S.C. §112, second paragraph.

Applicants also again respectfully acknowledge the Office's finding that claims 12-18 would be allowable if rewritten in independent form, including all of the limitations of the base claim and any intervening claims.

Finally, Applicants acknowledge the Office's finding that claims 61 and 63-65 would be allowable if rewritten in independent form, including all of the limitations of the base claim and any intervening claims.

## CONCLUSION

In view of the foregoing, favorable reconsideration and allowance of all pending claims are respectfully requested.

A check in the amount of \$510.00 is enclosed (in payment of a three-month extension of time fee for the filing of this Amendment C). The Commissioner is, however, hereby authorized to charge any underpayment or credit any overpayment to Deposit Account No. 19-1345.

Respectfully submitted,



Derick E. Allen, Reg. No. 43,468  
SENNIGER POWERS  
One Metropolitan Square, 16th Floor  
St. Louis, Missouri 63102  
(314) 231-5400

DEA/lrw  
Via EFS